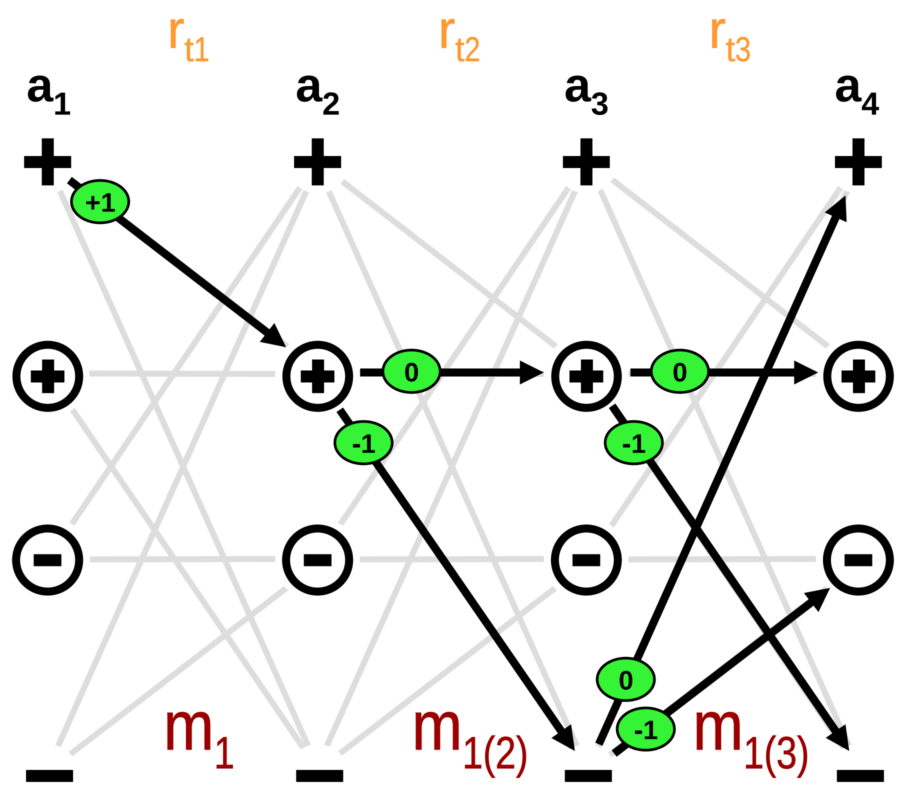
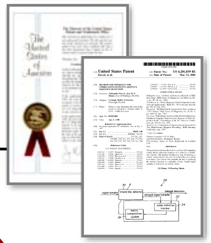
Exhibit A

Part 5

Kavcic-Moura Branch Metrics

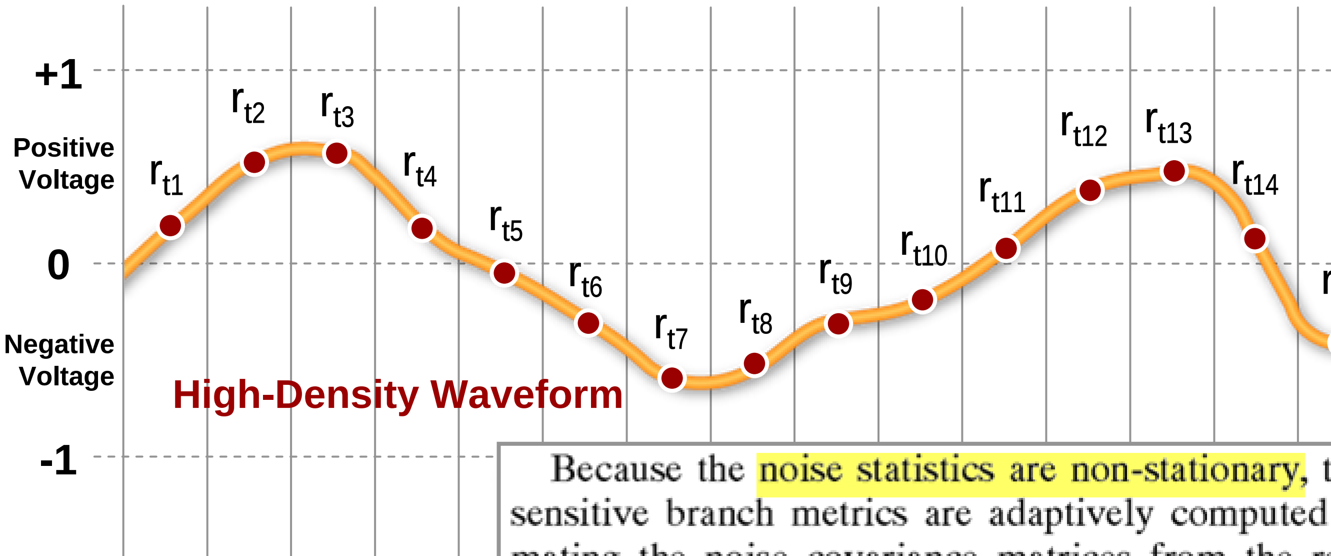


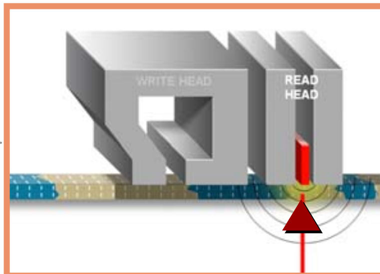


? ? ?

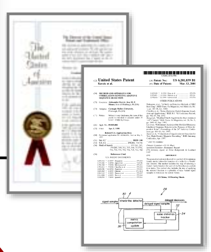
$$BM_1 = \log \sigma_1^2 + \frac{[(r_{t1}-m_1) + w_{1(2)}\cdot(r_{t2}-m_{1(2)}) + w_{1(3)}\cdot(r_{t3}-m_{1(3)})]^2}{\sigma_1^2}$$

Tracking the Noise Statistics





Because the noise statistics are non-stationary, the noise sensitive branch metrics are adaptively computed by estimating the noise covariance matrices from the read-back data. These covariance matrices are different for each branch of the tree/trellis due to the signal dependent structure of the media noise. Because the channel characteristics in mag-



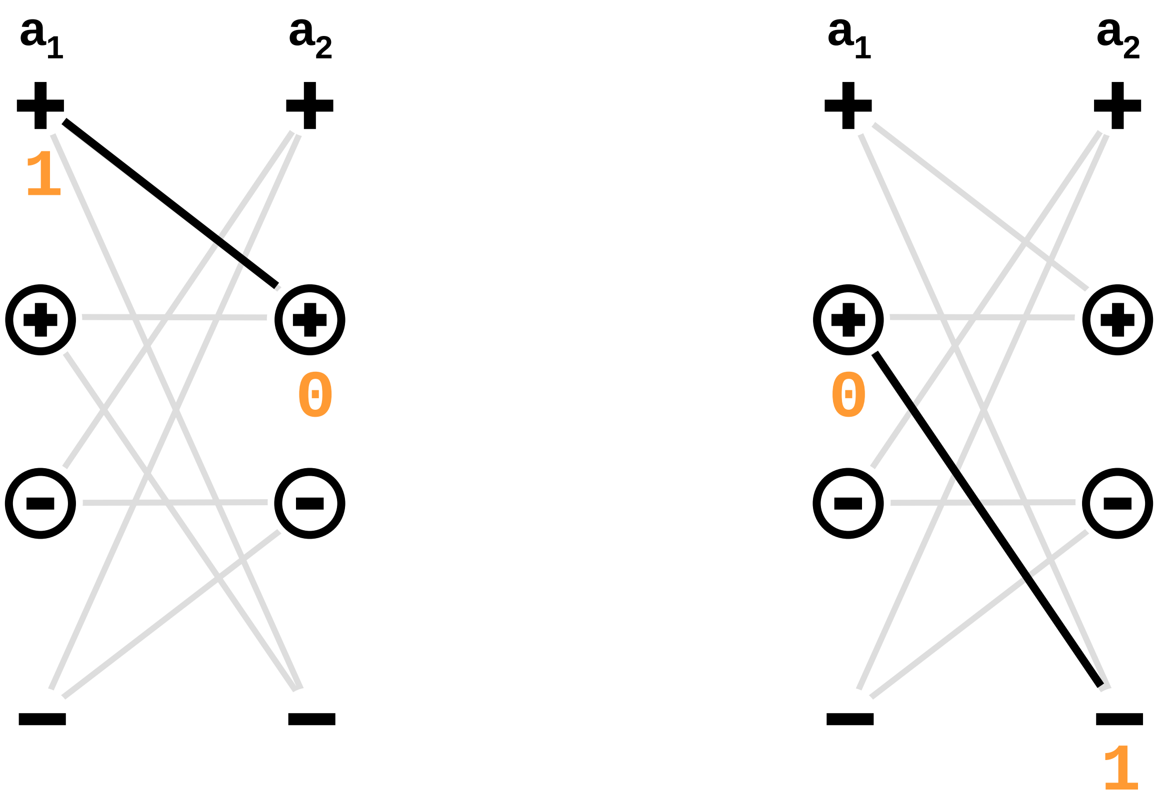
? ? ?

$$BM_1 = \log \sigma_1^2 + \frac{[(r_{t1}-m_1) + w_{1(2)}\cdot(r_{t2}-m_{1(2)}) + w_{1(3)}\cdot(r_{t3}-m_{1(3)})]^2}{\sigma_1^2}$$

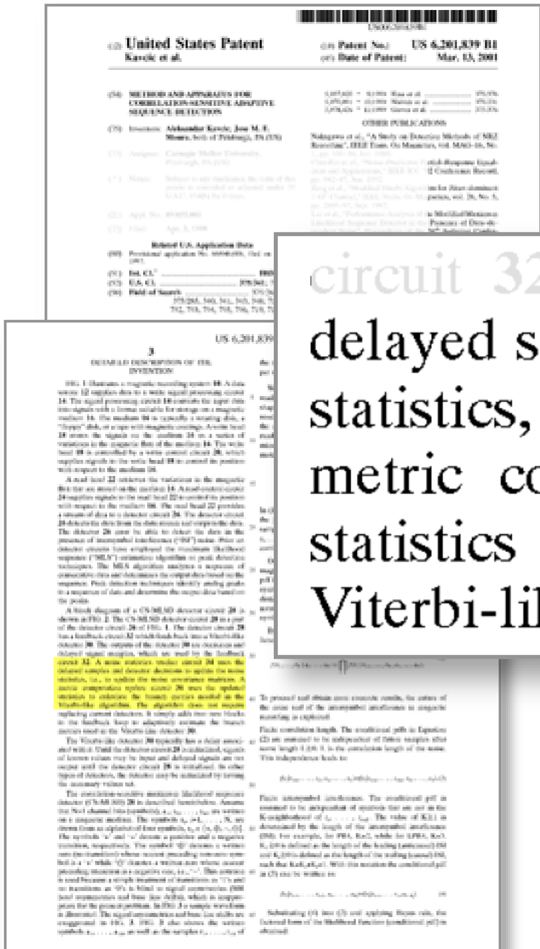
?

Source:
'839 Patent (2:15-20)

Calculating Accurate Branch Metrics



The Kavcic-Moura Patents

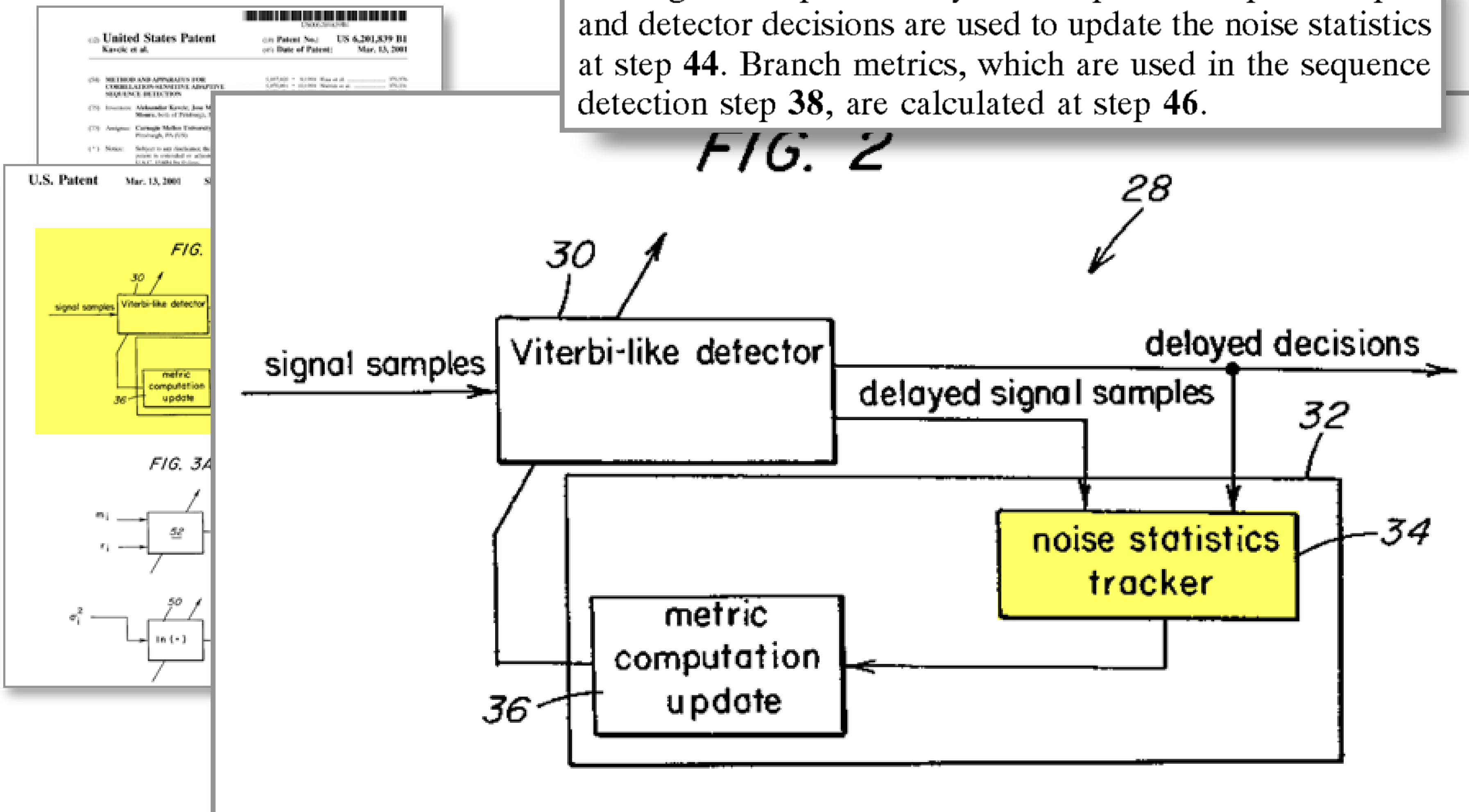

(12) United States Patent
Kavcic et al.
(10) Patent No.: US 6,201,839 B1
(45) Date of Patent: Mar. 13, 2001

circuit 32. A noise statistics tracker circuit **34** uses the delayed samples and detector decisions to update the noise statistics, i.e., to update the noise covariance matrices. A metric computation update circuit **36** uses the updated statistics to calculate the branch metrics needed in the Viterbi-like algorithm. The algorithm does not require

Source: '839 Patent (3:36-41)

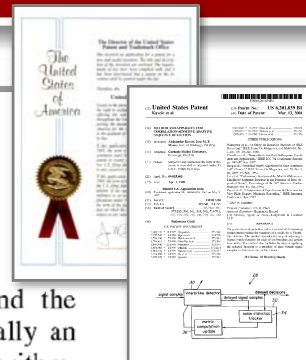
The Kavcic-Moura Patents

The signal sample is delayed at step **42**. The past samples and detector decisions are used to update the noise statistics at step **44**. Branch metrics, which are used in the sequence detection step **38**, are calculated at step **46**.



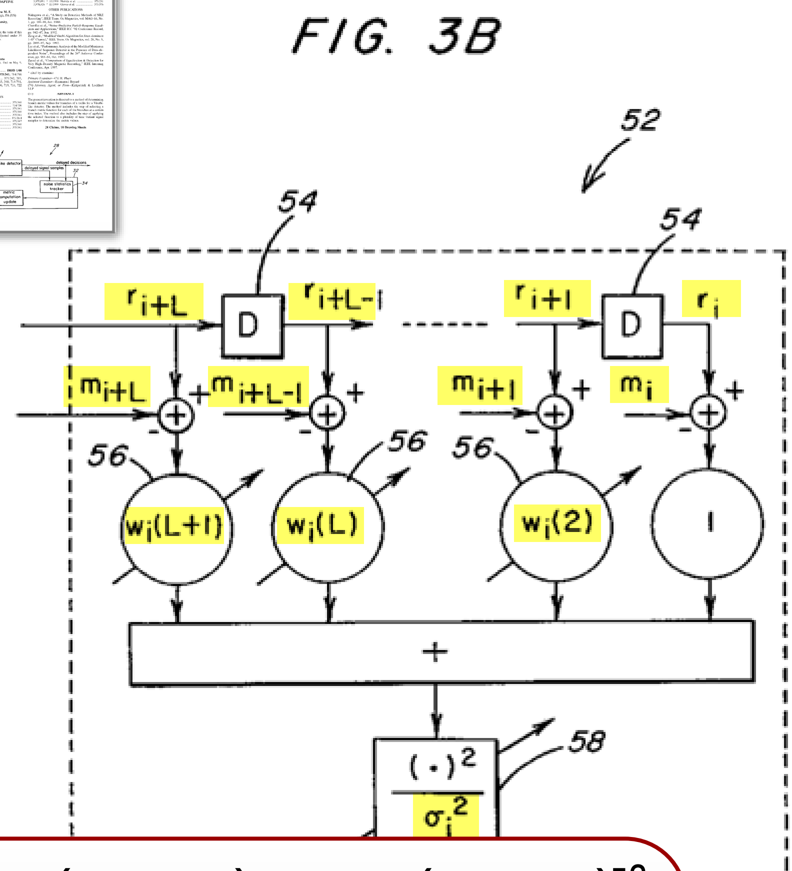
Source: ’839 Patent (11:16-19)

Branch Metric Computation Module



The adaptation of the vector of weights $\underline{w}_i$ and the quantity $\sigma_i^{\ 2}$ as new decisions are made is essentially an implementation of the recursive least squares algorithm. Alternatively, the adaptation may be made using the least mean squares algorithm.

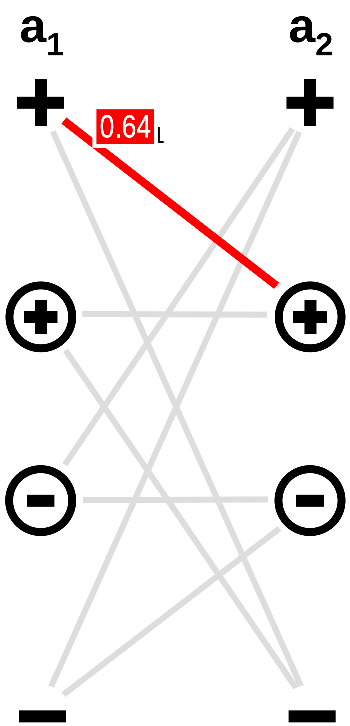
The quantities m_i that are subtracted from the output of the delay circuits **54** are the target response values, or mean signal values of (12). The arrows across multipliers **56** and across square devices **58** indicate the adaptive nature, i.e., the data dependent nature, of the circuit **52**. The weights $\underline{w}_i$ and the value $\sigma_i^{\ 2}$ can be adapted using three methods. First, $\underline{w}_i$ and $\sigma_i^{\ 2}$ can be obtained directly from Equations (20) and (16), respectively, once an estimate of the signal-dependent covariance matrix C_i is available. Second, $\underline{w}_i$ and σ_i^2 can be calculated by performing a Cholesky factorization on the inverse of the covariance matrix C_i. For example, in the $L_iD_i^{-1}L_i^T$ Cholesky factorization, $\underline{w}_i$ is the first column of the Cholesky factor L_i and $\sigma_i^{\ 2}$ is the first element of the diagonal matrix D_i. Third, $\underline{w}_i$ and $\sigma_i^{\ 2}$ can be computed directly from the data using a recursive least squares-type algorithm. In the first two methods, an estimate of the



$$BM_1 = \log \sigma_1^{\,2} + \frac{[(r_{t1}-m_1) + w_{1(2)}\cdot(r_{t2}-m_{1(2)}) + w_{1(3)}\cdot(r_{t3}-m_{1(3)})]^2}{\sigma_1^{\,2}}$$

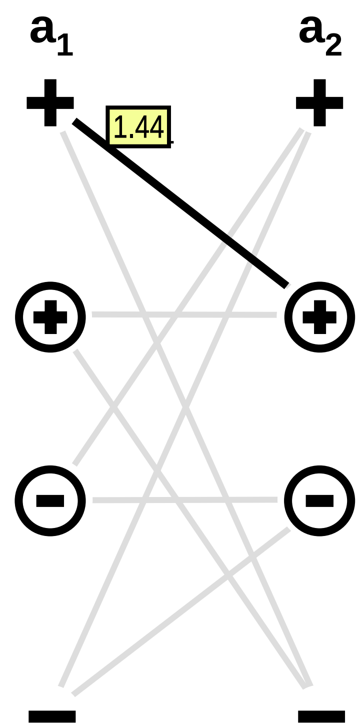
Source:
'839 Patent (8:1-21)

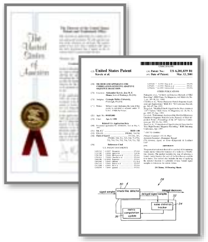
Calculating Accurate Branch Metrics



Prior Art

$$BM_1 = (r_{t1} - m_1)^2$$

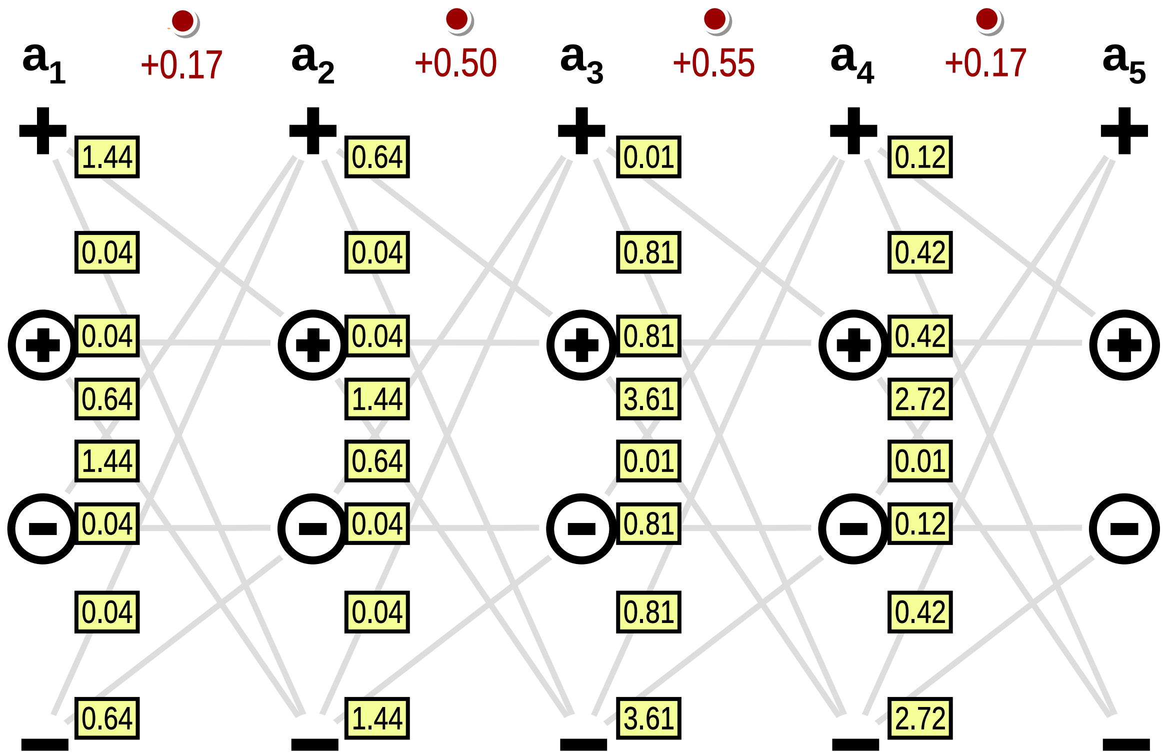


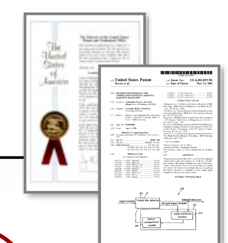


Kavcic-Moura Patents

$$BM_1 = \log \sigma_1^2 + \frac{[(r_{t1}-m_1) + w_{1(2)} \cdot (r_{t2}-m_{1(2)}) + w_{1(3)} \cdot (r_{t3}-m_{1(3)})]^2}{\sigma_1^2}$$

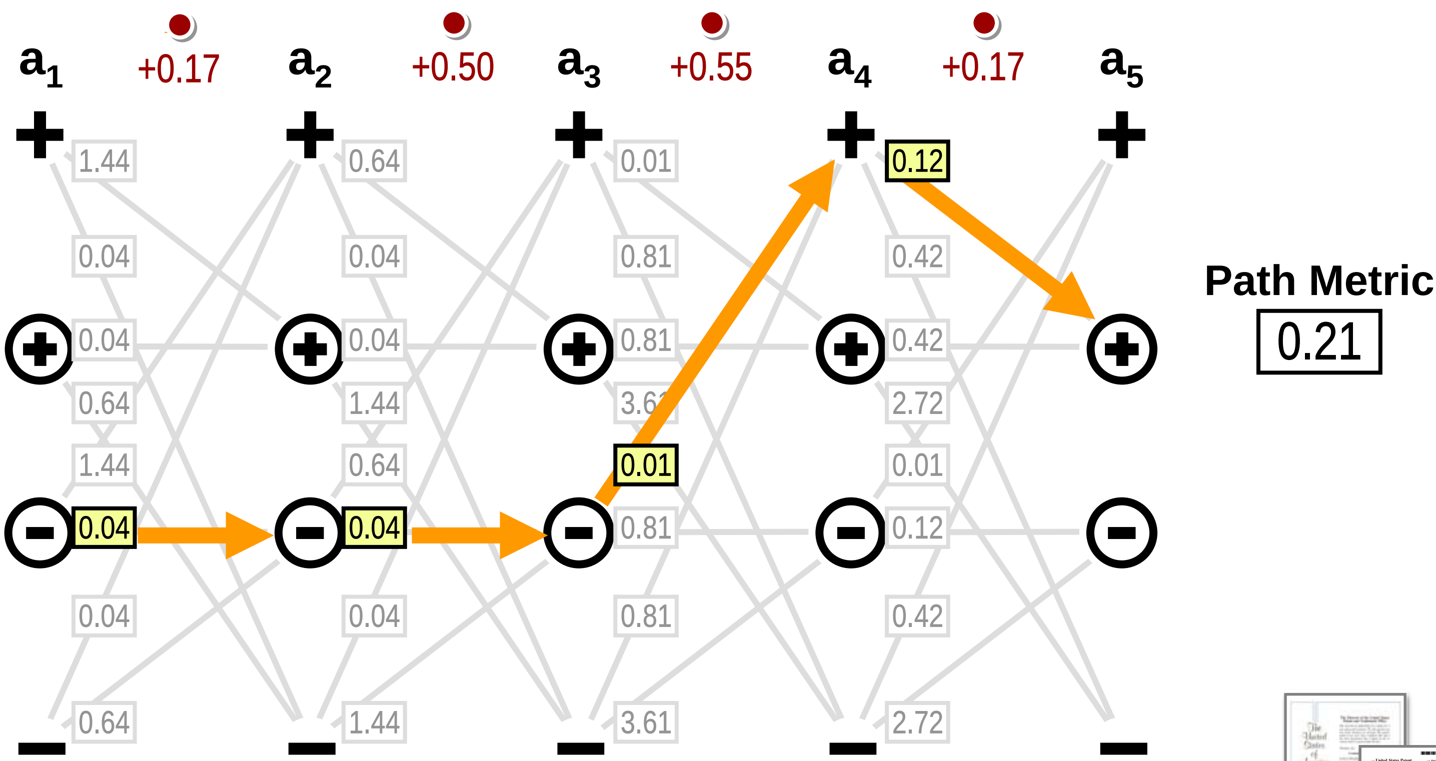
Kavcic-Moura Branch Metrics

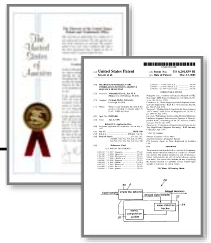




$$BM_1 = \log \sigma_1^2 + \frac{[(r_{t1}-m_1) + w_{1(2)}\cdot(r_{t2}-m_{1(2)}) + w_{1(3)}\cdot(r_{t3}-m_{1(3)})]^2}{\sigma_1^2}$$

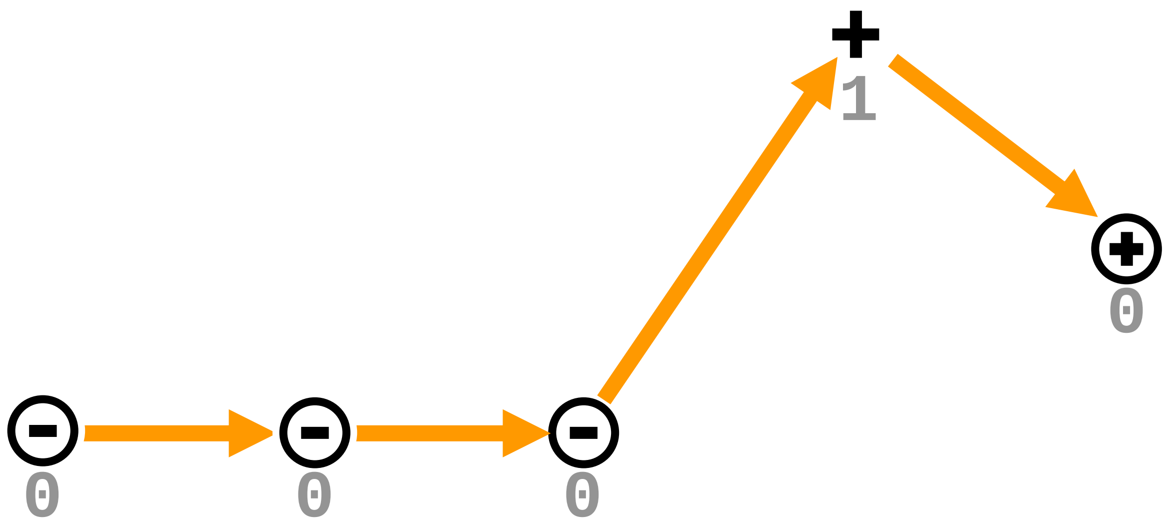
Path Metric

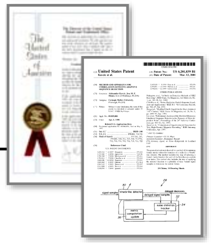




The path with the lowest cumulative total is the most likely bit sequence

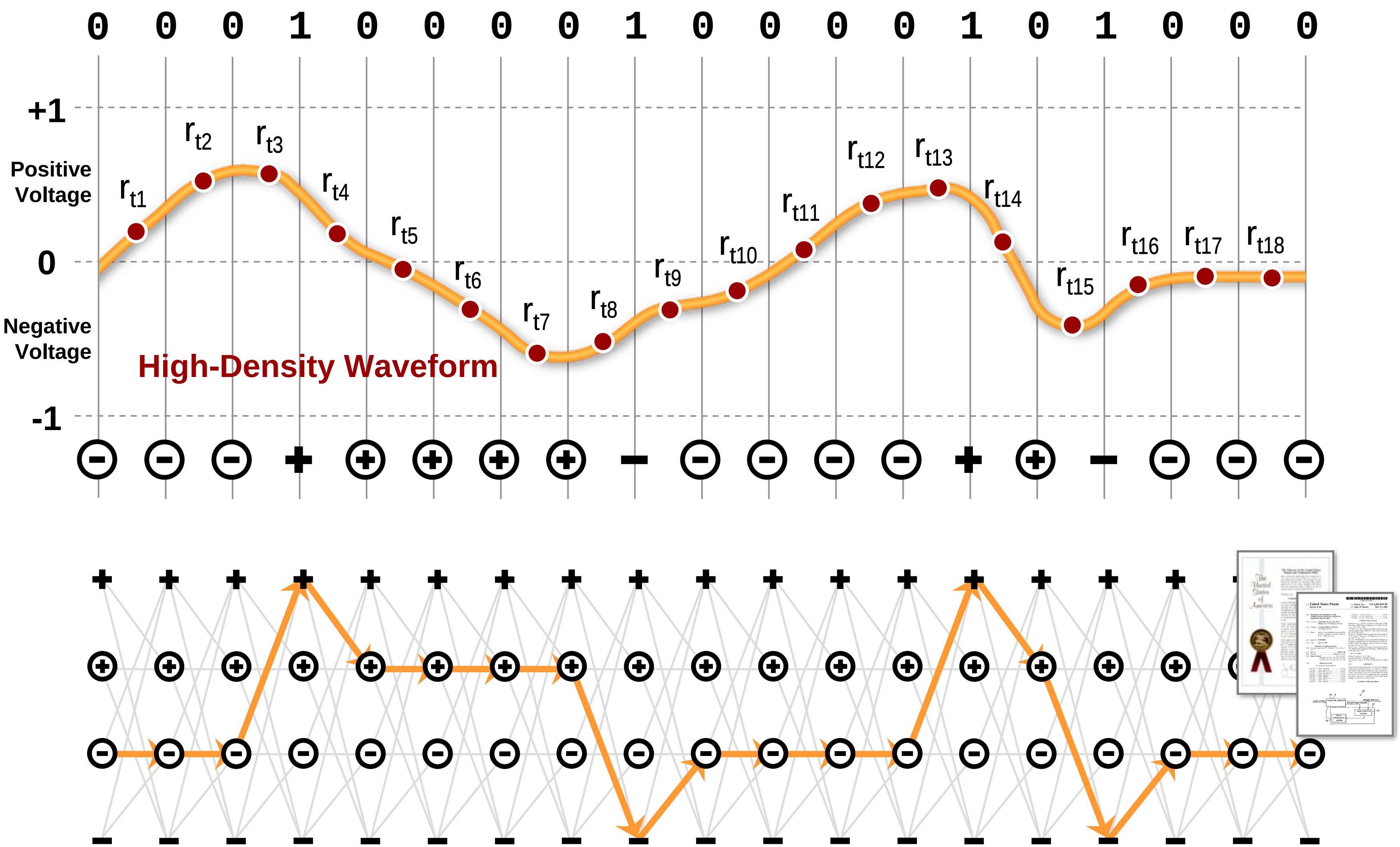
Most Likely Bit Sequence Found



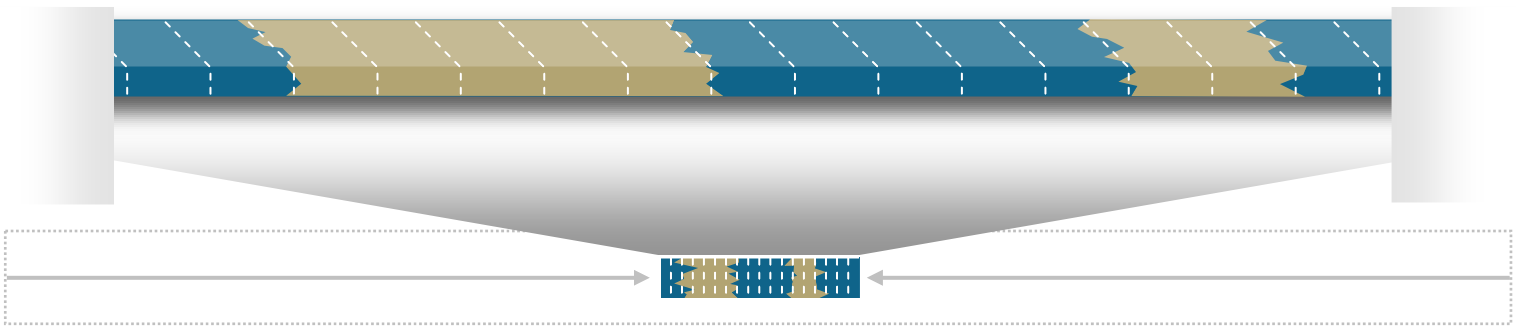


The path with the lowest cumulative total is the most likely bit sequence

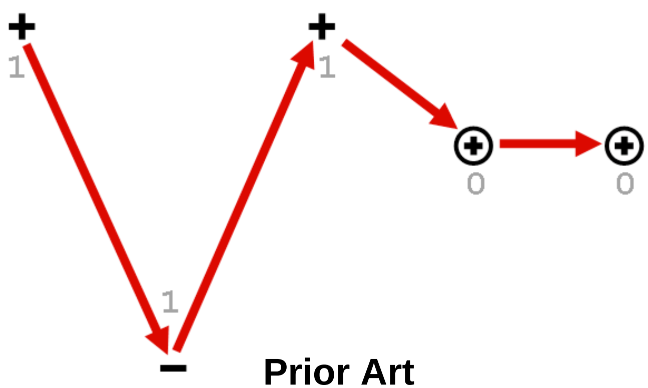
Determining the Bit Sequence



0 0 0 1 0 0 0 0 1 0 0 0 0 1 0 1 0 0 0

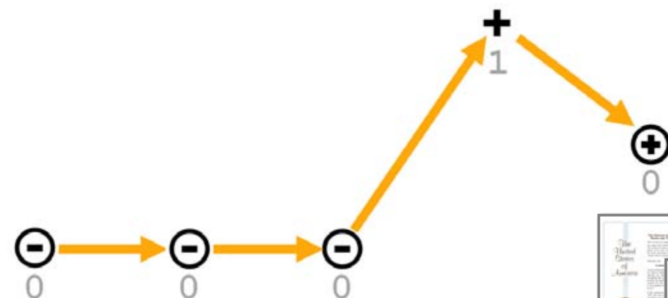


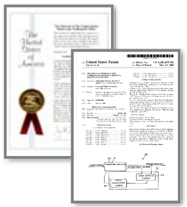
Calculating Accurate Branch Metrics



Prior Art

$$BM_1 = (\, r_{t1} - m_1)^2$$

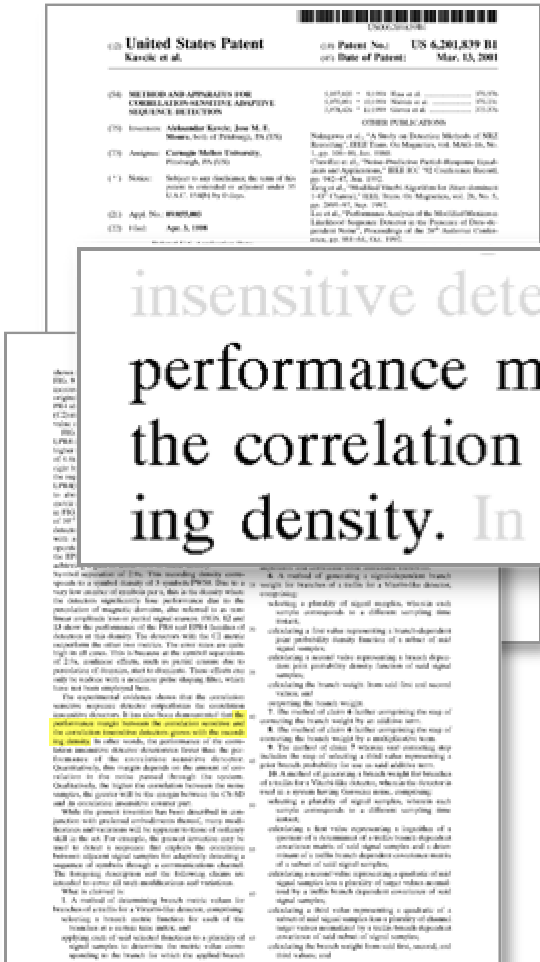




Kavcic-Moura Patents

$$BM_1 = \log \sigma_1^2 + \frac{[(r_{t1}-m_1) + w_{1(2)}\cdot(r_{t2}-m_{1(2)}) + w_{1(3)}\cdot(r_{t3}-m_{1(3)})]^2}{\sigma_1^2}$$

The Kavcic-Moura Patents


United States Patent
Kavcic et al.
Patent No.: US 6,201,839 B1
Date of Patent: Mar. 13, 2001

insensitive detectors. It has also been demonstrated that **the performance margin between the correlation sensitive and the correlation insensitive detectors grows with the recording density.** In other words, the performance of the corre-

Source: '839 Patent (13:40-43)

Thank You

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